CLAIMS

[1] A light-emitting element comprising a light-emitting layer including a phosphor, and at least two electrodes,

the light-emitting element comprising at least two kinds of electrically insulating layers with different dielectric constants,

wherein one of the electrically insulating layers is the light-emitting layer, and

one of the two electrodes is formed in contact with one of the insulating layers.

[2] The light-emitting element according to claim 1, wherein the at least two electrodes are formed on interfaces of the electrically insulating layers with different dielectric constants.

[3] The light-emitting element according to claim 1, wherein the other insulating layer is a gas layer, a ferroelectric layer, or a dielectric layer with a relative dielectric constant of 100 or more.

[4] The light-emitting element according to claim 3, wherein the ferroelectric layer or the dielectric layer is formed of at least one layer selected from a sintered layer, a mixed layer of a particle and a binder including a ferroelectric material or a dielectric material, and a molecular deposition thin film including a ferroelectric material or a dielectric material.

[5] The light-emitting element according to claim 3, wherein the ferroelectric layer further includes a back electrode.

[6] The light-emitting element according to claim 1, wherein the phosphor is a porous light-emitting body.

[7] The light-emitting element according to claim 6, wherein the porous light-emitting body includes at least one gas selected from air, nitrogen, and an inert gas.

[8] The light-emitting element according to claim 6, wherein the porous

light-emitting body is formed of a fine pore connected to a surface of the porous light-emitting body, a gas filled in the fine pore, and a phosphor particle.

[9] The light-emitting element according to claim 6, wherein the porous light-emitting body is formed of a phosphor particle or a phosphor particle coated with an insulating layer.

[10] The light-emitting element according to claim 6, wherein the porous light-emitting body has an apparent porosity in a range of not less than 10% to less than 100%.

[11] The light-emitting element according to claim 6, wherein the porous light-emitting body is formed of at least one particle selected from a phosphor particle and a phosphor particle coated with an insulating layer, and an insulative fiber.

[12] The light-emitting element according to claim 1, wherein the light-emitting element is in an atmosphere under pressure, atmospheric pressure, or a reduced pressure, and is sealed entirely.

[13] The light-emitting element according to claim 1, wherein a direct or AC electric field is applied between the at least two electrodes so as to cause surface discharge, whereby the light-emitting layer is allowed to emit light.

[14] The light-emitting element according to claim 3, wherein the gas layer is provided to have a thickness in a range of not less than 1 μm to not more than 300 μm.

[15] The light-emitting element according to claim 1, wherein the light-emitting layer is divided into a plurality of parts by discharge separation means with respect to each pixel.

[16] The light-emitting element according to claim 15, wherein the discharge separation means is formed of a partition wall.

[17] The light-emitting element according to claim 15, wherein the

partition wall is made of an inorganic material.

[18] The light-emitting element according to claim 15, wherein the discharge separation means is formed of a space.

[19] The light-emitting element according to claim 3, wherein the gas layer is partitioned by a rib in a thickness direction.

[20] The light-emitting element according to claim 1, wherein the light-emitting layer emits light of at least red (R), green (G), or blue (B) separately.

[21] The light-emitting element according to claim 1, wherein the at least two electrodes are arranged so as to sandwich the at least one dielectric layer and the light-emitting layer therebetween, and an AC electric field is applied so as to cause surface discharge in the light-emitting layer, whereby the light-emitting layer is allowed to emit light.

[22] The light-emitting element according to claim 1, wherein the at least two electrodes are an address electrode and a display electrode, respectively.

[23] The light-emitting element according to claim 1, wherein the at least one electrode is a transparent electrode arranged on an observation side.

[24] The light-emitting element according to claim 3, wherein the gas layer is formed at at least one portion selected from a portion between the light-emitting layer and the observation side of the transparent electrode and a portion between the light-emitting layer and the back electrode.

[25] The light-emitting element according to claim 1, wherein the light-emitting layer is a porous light-emitting layer, and the porous light-emitting layer is arranged in contact with a ferroelectric layer.

[26] The light-emitting element according to claim 25, wherein at least one of the electrodes is arranged on the porous light-emitting layer so that an alternating electric field applied between the at least two electrodes also is applied to a part of the porous light-emitting layer.

[27] The light-emitting element according to claim 25, wherein the at least two electrodes are formed so as to sandwich the ferroelectric layer and the porous light-emitting layer therebetween.

[28] The light-emitting element according to claim 25, wherein the at least two electrodes both are formed on the ferroelectric layer.

[29] The light-emitting element according to claim 25, wherein the at least two electrodes both are formed at a boundary between the ferroelectric layer and the porous light-emitting layer.

[30] The light-emitting element according to claim 25, wherein one of the at least two electrodes is formed at a boundary between the ferroelectric layer and the porous light-emitting layer, and the other electrode is formed on the ferroelectric layer.

[31] The light-emitting element according to claim 1,

wherein one of the electrically insulating layers is a ferroelectric layer,

the at least two electrodes include a pair of electrodes and another electrode,

a pair of the electrodes are arranged so that an electric field is applied to at least a part of the ferroelectric layer, and

the other electrode is arranged so that an electric field is applied to at least a part of the light-emitting layer provided between the other electrode and at least one of a pair of the electrodes.

[32] The light-emitting element according to claim 1, wherein a predetermined electric field or higher is applied to the light-emitting layer, so that electric charge transfer is carried out, whereby the light-emitting layer is allowed to emit light.

[33] The light-emitting element according to claim 1, wherein an electron-emitting body further is provided toward the light-emitting layer,

and the light-emitting layer is arranged adjacent to the electron-emitting body so as to be irradiated with electrons generated from the electron-emitting body.

[34] The light-emitting element according to claim 33, wherein the electron-emitting body includes a cathode electrode, a gate electrode, and a Spindt-type emitter interposed between the two electrodes, and electrons emitted from the Spindt-type emitter by application of a gate voltage between the cathode electrode and the gate electrode are irradiated to the light-emitting layer, whereby the light-emitting layer is allowed to emit light.

[35] The light-emitting element according to claim 34, wherein the Spindt-type emitter has a cone shape.

[36] The light-emitting element according to claim 34, wherein the Spindt-type emitter is made of at least one metal selected from molybdenum, niobium, zirconium, nickel, and molybdenum steel.

[37] The light-emitting element according to claim 33, wherein the electron-emitting body includes a cathode electrode, a gate electrode, and a carbon nanotube interposed between the two electrodes, and electrons emitted from the carbon nanotube by application of a gate voltage between the cathode electrode and the gate electrode are irradiated to the light-emitting layer, whereby the light-emitting layer is allowed to emit light.

[38] The light-emitting element according to claim 33, wherein the electron-emitting body is a surface-conduction-type electron-emitting element, a gap is provided in a metal oxide film, and electrons generated from the gap by application of an electric field to an electrode provided on the metal oxide film are irradiated to the porous light-emitting body, whereby the light-emitting layer is allowed to emit light.

[39] The light-emitting element according to claim 33, wherein the electron-emitting body is made of a silicon microcrystal with an oxide film

sandwiched between polysilicon with an oxide film, and electrons generated by application of a voltage to the silicon microcrystal with an oxide film are irradiated to the light-emitting layer, whereby the light-emitting layer is allowed to emit light.

[40] The light-emitting element according to claim 33, wherein the electron-emitting body includes a cathode electrode, a gate electrode, and a whisker emitter interposed between the two electrodes, and electrons emitted from the whisker emitter by application of a gate voltage between the cathode electrode and the gate electrode are irradiated to the light-emitting layer, whereby the light-emitting layer is allowed to emit light.

[41] The light-emitting element according to claim 33, wherein the electron-emitting body includes a cathode electrode, a gate electrode, and silicon carbide or a diamond thin film interposed between the two electrodes, and electrons emitted from the electron-emitting body by application of a gate voltage between the cathode electrode and the gate electrode are irradiated to the light-emitting layer, whereby the light-emitting layer is allowed to emit light.